INTRODUCTION

As part of the EIS environmental review process, the Project Team is evaluating the nine potential alternatives for the South Park Bridge Project. The alternatives include the following: the No Action Alternative (bridge closure), the Fixed High-Level Bridge Alternative, the Fixed Mid-Level Bridge Alternative, the Fixed Low-Level Bridge Alternative, the Movable Span Bascule Bridge Alternative, the Movable Vertical Lift Bridge Alternative, the Movable Swing Bridge Alternative, the Tunnel Alternative, and the Retrofit Alternative. These alternatives are briefly described in the following section.

A total of four different categories of evaluation criteria were developed. The Natural/Built Environment category included ten separate screening criteria. The Transportation Performance category included six screening criteria. The Design/Construction Measures category included six screening criteria. And the Financial Performance category included an additional three screening criteria. Below is a brief discussion of the analysis conducted to date on each of the project alternatives for each of the 25 screening criteria.

DESCRIPTION OF ALTERNATIVES

The 2% Screening Analysis has been based on a total of nine potential alternatives for the South Park Bridge Project. To assess impacts, each build alternative (excluding the Retrofit Alternative) was based on King County Road Standards using a design speed of 35 mph, a maximum grade of 8-9 percent, a 250 to 300 foot transition from new to existing cross section. No other design variances are assumed at this 2% level of effort. The 68-foot cross section for new bridge designs would accommodate four standard lanes for vehicle traffic, a bicycle lane on either side of the road pavement, and a sidewalk on both sides of the road. Each of these nine alternatives is described below.

For all the build alternatives described, it is assumed that the existing bridge structure would be removed entirely. It is possible to leave the existing bridge piers and abutments in place (with no movable center spans), but this would require approval from the Corps of Engineers.

No Action Alternative

For the No Action Alternative, it is assumed that the existing bridge structure would be closed in future years. No vehicular, bicycle, or pedestrian traffic would be allowed to use the bridge. At this time, the existing structural elements (e.g., movable spans, abutments, piers, mechanical elements) would be removed.

Fixed High-Level Bridge Alternative

For the Fixed High-Level Bridge Alternative, the existing bridge structure would be removed after the completion of the construction of the new bridge. The new bridge would be constructed approximately 80 ft. (centerline to centerline) west of the existing bridge and would require 8-9%

grades. Road improvements would extend north from S. Concord Street along the existing right-of-way of 14th Avenue S., cross the river, and continue north to and include E. Marginal Way S. It would require modification of the intersection of 16th Avenue S. and E. Marginal Way S. as well as the existing railroad tracks immediately south of this intersection. The bridge design would allow for a 100-foot vertical clearance and 125-foot horizontal clearance for river traffic.

Fixed Mid-Level Bridge Alternative

The Fixed Mid-Level Bridge Alternative would basically follow the same horizontal alignment as the Fixed High-Level Bridge Alternative, but the bridge profile would allow for a 60-foot vertical clearance for river traffic. South end road improvements would extend south of S. Donovan Street. At the north end, roadway improvements would not be required at 16th Avenue S. and E. Marginal Way S. or for the existing railroad tracks south of this intersection. The bridge design would allow for approximately a 125-foot horizontal clearance for river traffic.

Fixed Low-Level Bridge Alternative

The Fixed Low-Level Bridge Alternative would follow the same horizontal alignment as the Fixed High-Level and Fixed Mid-Level Bridge Alternatives, except the bridge profile would be 35 feet clear of the river (same as the existing bridge). The south roadway improvements would extend north of a point mid-block between S. Cloverdale and S. Donovan streets. The north end project terminus would be located south of the intersection of 16th Avenue S. and E. Marginal Way S. Similar to the Fixed Mid-Level Bridge Alternative, the bridge design would allow for an approximately 125-foot clearance for river traffic.

Movable Span Bascule Bridge Alternative

The Movable Span Bascule Bridge Alternative would follow the same horizontal and vertical alignment as the Fixed Low-Level Bridge Alternative. Like the existing bridge, the bridge profile would be 35 feet clear of the river. The mid-section spans could cantilever open to allow unlimited river traffic to travel upstream of the bridge. The north and south new roadway terminus would be similar to the Low-Level Bridge Alternative. The navigable river channel dimensions would be similar to the existing and would be approximately 15 feet deep and 125 feet wide.

Movable Vertical Lift Bridge Alternative

The Movable Vertical Lift Bridge Alternative would follow the same horizontal and vertical alignment as the Fixed Low-Level Bridge Alternative. Like the existing bridge, the bridge profile would allow approximately 35 clear of the river but the middle span of the bridge would be movable to allow passage of boats and barges. The movable span of this bridge allows for a center section of the bridge to be raised approximately 100 feet in height above the bridge deck. Support structures to operate the bridge would extend approximately 150-200 feet above the bridge deck. Similar to the Fixed Mid-Level Bridge Alternative, the bridge design would allow

for an approximately 125-foot clearance for river traffic. The north and south new roadway terminus would be similar to the Low-Level Bridge Alternative.

Movable Swing Bridge Alternative

The Movable Swing Bridge Alternative would follow the same vertical alignment as the Fixed Low-Level Bridge Alternative, but the horizontal alignment requires two mid-span bridge sections to rotate approximately 150 feet from the existing bridge centerline. This alignment change is required to accommodate construction of the Movable Swing Bridge Alternative. This bridge design would provide unlimited boat heights to travel upstream. Like the existing bridge, the bridge profile would allow approximately 35 clear of the river. The south and north termini of the roadway project would be similar to the Fixed Low-Level Bridge Alternative.

Tunnel Alternative

The Tunnel Alternative would differ entirely from any of the other build alternatives, as a new bridge would not be constructed to replace the existing bridge. Rather, two parallel tunnels would be constructed under the river. The construction of the Tunnel Alternative could be accomplished using a tunnel-boring machine or cut-and-cover methods. For a bored tunnel alternative (based on previous geotechnical information), the top of the tunnels would need to be more than 80 feet below the existing river bottom. For a cut-and-cover tunnel, the top of the tunnels could be 7 to 10 feet below the existing river bottom. Both tunnel options would assume avoiding impacts beyond W. Marginal Way to minimize impacts to Boeing Field. The south terminus of this roadway project would extend south of S. Trenton Street for the cut and cover option and would extend south of S. Henderson St. for the bored option further south than any of the fixed span alternatives. For purposes of analysis of the worst-case scenarios, the environmental impacts of this alternative assume the cut-and-cover methodology would be used. In essence, the necessary roadway improvements would be very similar to the Fixed High-Level Bridge Alternative.

Retrofit Alternative

For this alternative, the existing bridge would remain in place and the structure would be reinforced and the equipment used to operate the bridge would be refurbished and/or replaced. Because studies have confirmed the existing bridge support piers are shifting in the river bottom, the main focus of the rehabilitation work would be to stabilize the piers. More than likely, a concrete casing would be constructed around the outside of the existing pier structures and extend into the river bed to a depth exceeding the depth of the current pier structures. The exterior of the bridge structure would generally not require significant changes and would preserve the historic character of the existing bridge. To meet current road safety guidelines, the number of lanes on the roadway would be reduced from four substandard lanes to three standard lanes, two southbound lanes and one northbound lane. Bicycle and pedestrian traffic would continue to be able to use the bridge.

NATURAL/BUILT ENVIRONMENT

Consistency with Plans and Policies

In the screening of the alternatives, PB evaluated each alternative and its consistency with existing land use plans and policies. For the South Park Bridge Project area, there are three local governments with jurisdictions. The industrial area south of E. Marginal Way S. is mostly located in the City of Seattle, though Boeing property north of the Duwamish River is located within the Tukwila city limits. The blocks south of the Duwamish River and north of Dallas Avenue S. are located in unincorporated King County, but the remaining properties south of Dallas Avenue S. are again located in the City of Seattle. As such, there are potentially three different local government land use comprehensive plans with jurisdiction over land uses in the project area.

A brief review of the land use plans for each of these three jurisdictions generally revealed a lack of specificity with respect to the future development of land uses and/or improvement to 14th Avenue S. and the 16th Avenue S. Bridge. This is especially the case considering all of the land located north of the Duwamish River is owned by one entity, the Boeing Company, and that portion of the project area that lies within the unincorporated portion of King County includes just a few properties. Moreover, King County officials have held discussions to consider Seattle annexation of this narrow "peninsula" at some time in the future.

Property owners and residents in the project area, irrespective of which jurisdiction, identify with the South Park Neighborhood. In 1998, this community prepared a neighborhood plan for adoption by the City of Seattle. As stated in the neighborhood plan cover letter, the plan captures the unique community goals and carries out the vision of the Seattle Comprehensive Plan (1994). Key elements in the neighborhood plan call for improving the 14th Avenue S. retail commercial area, keeping truck traffic off of residential streets, and improving bus services to this primarily residential community. Specifically, the plan calls for a variety of measures to improve intersections, streetscape, and on-street parking on 14th Avenue S.; and to preserve and enhance the neighborhood commercial district. Related to the proposed project, the objective of many of these goals is to encourage improvements to 14th Avenue S. without sacrificing the viability of the neighborhood commercial district.

The adopted City of Seattle Comprehensive Plan, 1994 as amended (January 2001) incorporated a number of the South Park Neighborhood Plan goals and policies. Specific goals in this document address the community desires to enhance the neighborhood, encourage commercial and industrial development, preserve the existing residential character, and continue to support the neighborhood's role as the service center for surrounding areas. The plan calls for consideration of opportunities to increase accessibility within the neighborhood, though improvements to 14th Avenue S. are not specifically identified. The goals also encourage inter-jurisdictional partnerships to address future planning issues based on collaborative efforts with South Park residents and businesses.

Evaluation of the potential project alternatives with respect to consistency with plans and policies focused on the neighborhood concern for South Park, particularly the potential land use impacts along 14th Avenue S., the neighborhood commercial core. Based on 2% engineering drawings and King County road standards, most of the alternatives would require the acquisition of commercial and light industrial properties on 14th Avenue S. This impact would be contrary to the adopted neighborhood goals and policies. Future redevelopment of commercial properties acquired for the construction of the bridge alternatives, however, would be consistent with the neighborhood goals. Opportunities for redevelopment, however, are not analyzed as part of this screening of alternatives.

Considering these issues, PB evaluated each of the South Park Bridge Project alternatives. Generally, the alternatives involving the construction of a new bridge would not be consistent with the City's adopted land use plans and policies to preserve and/or enhance the commercial district. Rehabilitation of the existing bridge would be most beneficial to the commercial core, as existing commercial properties would not be acquired. The Tunnel and Fixed High-Level Bridge Alternatives would result in considerable impacts to the commercial core due to the extreme length of these alternatives, which would require the acquisition of a large proportion of the properties in the commercial district. The No Action Alternative also could result in adverse impacts to the commercial district, despite the lack of right of way acquisitions. The sharp reduction in traffic flow through the commercial district due to bridge closure could also jeopardize the economic viability of some businesses.

Residential Displacements/Relocations

PB evaluated the potential for residential displacement and relocations for each of the alternatives based on a site visit on April 24, 2002. For the 2% alternatives screening analysis, displacements include right of way acquisition with or without the need to acquire associated residential structures on the property.

In the South Park Bridge Project area, there are two residential properties that could potentially be affected by the construction of a new bridge across the Duwamish River. One residence is located at 14th Avenue S. immediately adjacent to the existing bridge ramp at S. Orr Street. The other residential structure is an older residence that has been converted into several apartments. This structure is located on the east side of 14th Avenue S. between S. Cloverdale and S. Donovan streets.

Except for the No Action and Retrofit Alternatives, each of the alternatives for the construction of a new bridge would require the acquisition of right of way from one or both residential properties described above. The acquisition of the more northern residence would be likely for each of these alternatives due to its close proximity to the existing bridge structure and proposed alignments for the new bridges or tunnel. The need to acquire the southern residential structure would not likely be required as this structure is set back from the existing sidewalk. As neither the No Action nor the Retrofit alternatives would require the acquisition of additional right of way, neither of the residential properties would be impacted.

Commercial/Industrial Displacements/Relocations

PB evaluated the potential for commercial and/or industrial displacement and relocations for each of the alternatives based on a field visit on April 24, 2002. For the 2% alternatives screening analysis, displacements include right of way acquisition with or without the need to acquire associated structures on the property.

In the South Park Bridge Project area, there are both commercial and industrial properties. The Boeing Company owns property on both sides of the existing roadway north of the Duwamish River and south of E. Marginal Way S. Large manufacturing buildings and associated office buildings are located on these parcels. Buildings are located along nearly the entire length of the east side of the roadway. In contrast, the large buildings on the west side of the road are set back considerably from the existing right of way, though several smaller structures are scattered in and among several employee parking areas located immediately to the east of the roadway.

In contrast, 14th Avenue S. south of the Duwamish River is lined by many small commercial retail and office uses. In addition, there is a large marina operation on both sides of the existing roadway on the south shore of the river and several smaller light industrial and warehouse businesses further to the south. In nearly all cases, the foundations of existing commercial and industrial buildings are built nearly flush with the existing sidewalk. As such, the acquisition of right-of-way for all alternatives, except the No Action and Retrofit Alternatives would require the acquisition of associated buildings.

The number of commercial and/or industrial properties potentially affected by the project alternatives ranged between 10 and 23. The Fixed Low-Level, Movable Span Bascule, and Movable Vertical Lift Bridge Alternatives would each affect an estimated 10 properties. The Movable Swing Bridge Alternative would affect an estimated 11 properties. The Fixed Mid-Level Bridge Alternative affects an estimated 17 properties. The Fixed High-Level Bridge and Tunnel Alternatives would affect potentially 23 properties. Neither the No Action nor the Retrofit Alternatives would require the acquisition of any commercial or light industrial properties.

Neighborhood Cohesion

PB evaluated potential long-term impacts to neighborhood cohesion in the South Park Neighborhood. This criterion evaluates the potential changes in pedestrian, bicycle, and vehicular access to neighborhood commercial services, public services, and recreation facilities. In addition, this criterion evaluates changes in access between neighborhoods and residential districts within the community.

The key factor considered in making this evaluation of the 2% alternatives included changes in local street access to 14th Avenue S. and the South Park Bridge, including street closures, traffic reroutes, and traffic diversions.

As the No Action and Retrofit alternatives would not require any modifications to existing intersections, these alternatives were considered most beneficial to the community in comparison to the other alternatives. The Fixed Low-Level, Movable Span Bascule, Movable Vertical Lift, and Movable Swing Bridge alternatives were considered to have modest impacts on pedestrian, bicycle, and vehicular access within the community as each alternative would require the closure of one or two streets. In contrast, the extreme length of the alignment of the Fixed High-Level Bridge, Fixed Mid-Level Bridge, and Tunnel alternatives would result in significant changes to existing access in the community as each of these alternatives would require road closures and/or the construction of one or more underpass or overpass, which would prohibit access to the bridge or tunnel.

Historical/Archaeological

On April 25, 2002, Historical Research Associates (HRA) visited the South Park Bridge redevelopment project area in order to make a preliminary visual assessment on cultural resource effects. HRA determined that the Project might have a substantial effect on cultural resources in the South Park community. The bridge and its approaches would have a direct effect on properties that require demolition or that are located directly adjacent to properties that would require demolition. Based on a visual assessment, HRA noted as many as eighteen historical (pre-1952) buildings in the South Park commercial district. Most of these buildings are located north of S. Donovan Street, an area impacted by all alternatives except the No Action and Retrofit alternatives. Additional affected resources include a historic-era Boeing building and the 14th Avenue S. Bridge, which is listed on the National Register of Historic Places.

The South Park commercial corridor generally features one-story wood frame or brick buildings. Some buildings are two-story, with commercial on the ground floor and apartments or offices on the second floor. The most notable building in this corridor is a two-story brick building at 8609-13 14th Avenue S. Inscribed on the front facade of the building is "South Park Hall," suggesting it is locally significant as a community gathering place.

West of the commercial corridor is a neighborhood of modest bungalows, craftsman, and farmhouses, many of which appear to date to the historical period. If 14th Avenue S. were widened to accommodate the new bridge, many of these properties – including those within one-half block of the roadway – could be affected. East of the commercial corridor are some houses, but the predominant land use is light industrial. Most of the industrial buildings appear to have been built during the modern period.

The South Park Bridge redevelopment project may have a moderate effect on subsurface archaeological resources in the South Park community. The bridge and its approaches are located on a landform sensitive for buried cultural resources. Numerous villages and resource procurement and processing sites dating to the prehistoric and ethnographic periods have been recorded along the Duwamish River. However, extensive development and alterations to the landscape carried out during the past 100 years may have adversely affected the integrity of buried cultural resources. Potential impacts on subsurface archaeological resources would be nearly the same for all alternatives, except the No Action Alternative.

Tribal Fishing

PB evaluated potential impacts resulting from each of the project alternatives to the existing practice of tribal groups and/or members who conduct fishing operations nearly year-around on the Duwamish River at the site of the existing 14th Avenue S. Bridge. These fishing activities currently include boat operators tying their boats to the bridge piers and/or attaching their fishing nets to either the piers or elements of the bridge deck.

Construction of all of the bridge alternatives, including the No Action Alternative, would affect the tribal fishing operations. Each of the build alternatives would involve construction activities to some extent occurring in the river. These construction activities would include either the construction of new bridge piers, re-enforcement of the existing piers, or the eventual removal of existing piers. The flow in the river, however, is substantial and for protection of the fisheries in the river, continued flow of water would be necessary during construction. More than likely, cofferdams would be installed around the construction activities to permit continued flow of the river. The tribal fishing operations, however, would not likely be allowed to tie their boats or nets to the piers, the bridge deck, or any other structures associated with the construction activities for at least some period during the construction period. Fishing operations could be possible both upstream and downstream of the construction zone.

Alternative bridge designs may or may not include piers or bridge decks that would allow for continuation of these tribal fishing activities. Lacking more information on the specifics of these fishing operations, it is also unclear whether or not the Tunnel Alternative would benefit the fishing activities. Moreover, each of the bridge design alternatives could possibly be modified to provide features that would allow for continued tribal fishing operations. Such modifications could be incorporated directly into the bridge design or could be suggested as a mitigation measure.

Fish and Wildlife

On April 26, 2002 a Senior Fish Biologist with Parametrix, Inc. conducted an evaluation of the eight build alternatives and the No Action Alternative being considered for the South Park Bridge Project. The following discussion provides the rational for decisions regarding the potential environmental impacts of the proposed 2% design alternatives on fisheries resources.

The potential impacts of the alternatives would be directly related to habitat characteristics at the Duwamish River crossing. These characteristics are relatively uniform within the existing and adjacent alignment options. Thus, bridge alignment is not likely to produce a discriminating factor for the South Park Bridge alternatives.

Factors that differ among the alternatives are primarily the amount of shoreline, bottom and water column space occupied by the support structures. Each proposed alternative includes some support structures placed within the river channel, but outside the navigation channel. The build alternatives incorporate substantial differences in the sizes of these support structures.

In addition, there is some potential difference among the alternatives regarding shading impacts. A higher-level bridge is likely to have slightly less shading impact than a lower level bridge of the same size and type. However, at this location and for the habitat present, shading impacts are likely to be minor. No salt marsh or shallow water vegetation of any significance appears to grow on the adjacent shorelines (note: this will be verified by a site inspection this summer).

No Action Alternative

With this alternative it is assumed that the existing bridge support structures would be removed. Thus, this alternative would remove all in-water and shoreline impacts to fish habitat.

Fixed High-Level Bridge Alternative

The 2% design drawings show that six round piers of about 6 feet in diameter would be placed within the river channel. The space occupied by these piers would be less than the existing support structure for the water column and river bottom. This would have slightly less shading impacts than lower level alternatives.

Fixed Mid-Level Bridge Alternative

The 2% design drawings show that six round piers of about 6 feet in diameter would be placed within the river channel. The space occupied by these piers would be less than the existing support structure for the water column and river bottom. This alternative would have slightly greater shading impact than a high-level bridge and slightly less than a low-level bridge.

Fixed Low-Level Bridge Alternative

The 2% design drawings show that six round piers of about 6 feet in diameter would be placed within the river channel. The space occupied by these piers would be less than the existing support structure for the water column and river bottom. This alternative would have about the same shading impacts as the existing bridge.

Movable Span Bascule Bridge Alternative

The Movable Span Bascule Bridge Alternative would require two large support structures (about 45 ft x 100 ft) within the river channel. The space occupied by these structures would be as much as or more than the existing support structure for the water column and river bottom.

Movable Vertical Lift Bridge Alternative

The Movable Vertical Lift Bridge Alternative would require two large support structures (about 30 x 100 ft) within the river channel. The space occupied by these structures would be about the same as the existing support structure for the water column and river bottom.

Movable Swing Bridge Alternative

The movable bridge would require two large support structures (about 60 feet in diameter) the river channel, plus shoreline construction of several piers. The space occupied by these structures would be about the same as or slightly less than the existing support structure for the water column and river bottom.

Tunnel Alternative

This alternative would remove all in-water and shoreline impacts to fish habitat and fishing from the project area, assuming the existing bridge would be removed with completion of the tunnel.

Retrofit Alternative

This alternative would retain all existing in-water and shoreline impacts to fish habitat and fishing.

Visual Quality

PB evaluated the potential impacts to the visual quality of the South Park Bridge Project area based primarily on the height of the bridge deck of each alternative and compared this elevation to adjacent building heights. Any additional structures associated with the operation of movable bridge spans were isolated and likely momentary visual elements in the environment and were excluded from the analysis.

Buildings north of the Duwamish River are large industrial buildings that are the equivalent to 4-5 stories based on a casual visual inspection during a field trip to the project area on April 24, 2002. As such, these buildings would be approximately 48-60 feet in height, assuming 12 feet per floor. In contrast, the buildings on the south side of the Duwamish River are small-scale residential and commercial buildings. Most of these buildings are one story, which would be approximately 12-20 feet in height to the roofline. The several small warehouses and light industrial buildings would extend to perhaps 30-35 feet in height. Thus, the general height of buildings on the south side of the river is much lower than buildings on the north, and therefore, should be the benchmark for any comparison to the height of alternative bridge decks in order to present a worst-case assessment.

Based on the 2% engineering drawings of the alternatives, the bridges range in elevation above the adjacent shoreline ground level of zero feet (the Tunnel Alternative) to approximately 100 feet (the Fixed High-Level Bridge Alternative). The Fixed Mid-Level Bridge Alternative would be approximately 60 feet in height. The majority of the bridge alternatives including the Fixed Low-Level, Movable Span Bascule, Movable Vertical Lift, and Movable Swing Bridge alternatives would each be approximately 35 feet in height, the same height as the existing bridge. Additional isolated structures would also extend above the bridge deck for the bascule, vertical lift, and swing bridge designs. The Retrofit Alternative would also be 35 feet in height. The No Action Alternative assumes closure and removal of the existing bridge, thus the visual impacts of this alternative would be the least of all the alternatives.

HAZARDOUS SUBSTANCES/TOXIC WASTE

South Park Bridge Project Area

The community of South Park is located on the western shore of the Duwamish River, approximately seven miles upstream from the mouth of the river, Elliott Bay. The community of South Park is in the southern portion of the South Park Bridge Project area. The northern area of the South Park Bridge Project area is The Boeing Company's (Boeing's) Plant II facility (Plant II facility). The Boeing Plant II facility is a late 1930s to early 1940s aircraft manufacturing and assembly facility that occupies approximately 1.5 miles of the eastern shore of the Duwamish River.

The portion of the Duwamish River crossed by the South Park Bridge Project is located in the inter-tidal zone. The river level at this location fluctuates daily with tide cycle. At low tide, several drains and discharge pipes can be observed along both shores of the river.

The area in and around South Park became more developed and more industrial starting in the mid-1930s through the early-1950s. Rapid growth in the South Park area paralleled the development of Boeing's operations on the east side of the Duwamish River across from South Park. The types of operations at the properties within the project area have varied over time. In several cases, the current operations at these properties do not reflect there past industrial activities.

Summary Screening of Activities

Properties within the project area were screened initially by reviewing the following publicly available information: 1) the City of Seattle's Geographical Information System (GIS) database; 2) historic and current aerial photographs; and 3) federal and state agency records and database for Superfund sites and other cleanup actions. Properties were flagged for site visits based on the findings of the review of the public information. Site visits were conducted of the flagged properties.

Properties identified by the screening process have a high probability of having environmental impacts to the subsurface media of soil, groundwater, and/or sediment. Subsurface media are interconnected and allow for contamination to be transmitted away from the source area. Subsurface environmental impacts can migrate through the soil and groundwater to an adjacent property and/or to sediments in the river. Environmental impacts to media within a project area can significantly burden any construction project with additional cost to mitigate these clean-up impacts.

The findings for the South Park Bridge 2% screening criteria for hazardous substances in the subsurface of properties within the project area are summarized below.

Geographical Information System

The City of Seattle's GIS land use database was searched for all properties within the South Park Bridge Project area that are listed as being Heavy Industrial and/or General Industrial. Those properties identified and/or listed as industrial were placed on the screening list for site visits.

Aerial Photographs

Seven sets of aerial photographs taken within the South Park Bridge Project area from the 1930s, 1940s, 1950s, 1960s, 1970s, 1980s, and 1990s were obtained and analyzed to determine the types of past operations and activities that were conducted at a specific property over time. Properties that were found to have gas station operations, above ground storage tanks, industrial operations, ship repair yards, and/or auto junkyards were identified and added to the screening list for site visits.

Federal and State Agency Databases

The U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) (Superfund Site list) was reviewed for properties within the South Park Bridge Project area. Information listed by the Washington State Department of Ecology's (WADOE) on the WADOE's RCRA Cleanup Actions, the MTCA Site Cleanup Program, and the Hazardous Site Cleanup list also were reviewed for properties located within the South Park Bridge Project area. Any property that was listed on either the EPA's NPL or any of the WADOE lists were included on the screening list for site visits.

Site Visits

The initial screening of publicly available information flagged 46 properties within the South Park Bridge Project area as having the potential/likelihood of environmental impacts to subsurface media as a result of past and/or present operations. Site visits were conducted of all 46 properties. Each site visit consisted only of observations of the subject property from public locations. As these properties are privately owned, there was no physical entry onto the subject properties. Twenty-three of the properties that were visited have been determined to have at least a moderate potential for environmental impacts to the subsurface from the past and/or current release of hazardous substances from past and/or current operations. Fifteen of these 23 properties were determined to have a high potential for environmental impacts to the subsurface from the past and/or current release of hazardous substances from past and/or current operations.

In conclusion, this 2% alternatives screening analysis for Hazardous Substances constitutes only a preliminary screening of properties within the South Park Bridge Project area. As such, this screening was based only on the publicly available information and the site visits described above. No subsurface sampling was conducted and no review of existing sample results was undertaken in connection with this screening. Also note, this report addresses only the potential for subsurface contamination of hazardous substances; it does not address the potential for hazardous substances in the building structures which might be demolished as a result of the various bridge alignment scenarios under consideration that encroach onto properties within the project area. Hazardous substances inspection of these structures would be necessary in order to more fully assess the potential environmental impacts of the various bridge alignment scenarios, as well as, the potential costs of any required hazardous substances abatement activities that would be associated with demolition.

Noise

PB evaluated the potential for changes in noise levels for each of the alternatives. Changes in noise levels can be estimated for both construction and operation of the alternatives. Construction noise levels would generally be very similar for each of the alternatives, except for the noise generated by a tunnel-boring machine. The assumption for the Tunnel Alternative, however, evaluated the worst-case scenario, which is a cut-and-cover construction methodology using construction equipment similar to that used in the construction in any of the other alternatives. As such the construction noise impacts would be very similar for all of the alternatives, excluding the No Action Alternative; however, duration would vary between the alternatives. As such, evaluation of the alternatives for construction noise levels would be the same and would not distinguish any of the alternatives.

As construction noises would be only short-term, the evaluation of potential noise impacts for this screening purpose was conducted for operation of the alternatives, the more enduring noise impacts of the alternatives. For federally funded highway projects, traffic noise impacts occur when predicted noise levels approach or exceed noise abatement criteria established by the Federal Highway Administration. Per these federal guidelines, traffic noise levels are predicted for sensitive receptors near the project based on projected future traffic operations. The land uses in the South Park Bridge Project area most sensitive to noise levels are residential uses. Based on existing land uses in the immediate proximity, the only sensitive receptors in the project area are two single-family residences. Both of these residences are located along 14th Avenue S. south of the Duwamish River.

Noise levels predicted at these residences would be primarily dependent upon traffic flows past the properties. Because these residences are not directly adjacent to the proposed replacement structures, the height of the bridge decks, the operation of movable bridge spans, or a tunnel design for the bridge would not be expected to substantially affect noise levels. The proposed bridge designs for all of the build alternatives, except for the No Action Alternative, are based on nearly the same project traffic volumes. Rehabilitation of the existing bridge assumes three lanes. This design would accommodate projected traffic volumes, though level of service could be slightly reduced in comparison to the other build alternatives. This could slightly reduce noise level. As such, noise levels for each of the proposed build alternatives would be similar. The No Action Alternative, however, assumes the bridge would be closed and traffic volumes on 14th Avenue S. would be reduced and shifted to other roadways. This reduction in traffic volumes would result in a reduction in noise levels at sensitive noise receptors and an improvement in the ambient noise levels in the project area.

TRANSPORTATION PERFORMANCE

Transportation Analysis Review

A comprehensive traffic analysis was performed to assess the impacts of the various bridge alternatives on local traffic circulation and regional traffic flow. The below draft summarizes existing and future traffic conditions related to the design alternatives. The results shown are under review by all involved agencies.

Overview

King County is in the process of evaluating several design options for the historic South Park Bridge based on a directive to replace or rehabilitate the aging facility. As a requirement of this evaluation, a comprehensive traffic analysis was performed to assess the impacts of the various bridge alternatives on local traffic circulation and regional traffic flow. This report summarizes existing and future traffic conditions related to the design alternatives, the contents of which would be used to satisfy specific requirements for King County's preliminary design process. This work will also serve as a precursor for determining a preliminary preferred bridge alternative by screening the future traffic implications of each option. The design options under consideration include a variety of new fixed bridge structures, a new movable structure, and a rehabilitated three-lane facility. Removal of the bridge is also under consideration. For the purposes of the traffic analysis, a total of six scenarios were developed. These are listed below.

- Existing Conditions
- Year 2007 No-Action (Existing four lanes maintained)
- Year 2007 Rehabilitated Bridge (three lanes)
- Year 2007 No-Bridge (bridge closed)
- Year 2027 Long-Range New Bridge (four lanes)
- Year 2027 Long-Range No-Bridge (bridge closed)

The Year 2007 No-Action scenario assumes that the existing bridge would be reinforced and upgraded to enhance its structural integrity and extend the serviceable life of the facility. The Rehabilitated Bridge option would incorporate three lanes across the structure with two southbound lanes and one northbound lane. The Year 2027 New Bridge option encompasses all bridge replacement alternatives whether the facility is fixed or movable.

Evaluation of traffic conditions was divided into three basic tasks. The first task involved the development of existing intersection turning movement volumes through a combination of manual traffic counts and volume post-processing/balancing. Next, future peak hour volumes for the various design options were established via the King County EMME/2 travel demand forecasting model and incorporation of future land use and arterial network assumptions. The third task consisted of an area-wide level of service analysis for each of the six scenarios to determine the future degree of congestion at the primary intersections and access points within the study area. Results of this preliminary work are described and presented in three sections, 1) Existing Conditions, 2) Year 2007 Conditions, and 3) Long Range Year 2027 conditions.

Existing Conditions

Roadway Network

The existing roadway network surrounding the South Park Bridge consists of a variety of arterial types. Roadways range from local two-lane streets to major limited-access highway backbones. Regional traffic movement in the South Park area is concentrated to three north-south corridors including SR-99, SR-509, and E Marginal Way S. Local circulation is provided through a system of local and collector streets. Natural features such as the Duwamish Waterway and large-scale land uses such as the Boeing Airfield create barriers within the network and limit opportunities for access to/from the major regional routes. Characteristics of the key roadway facilities vary with respect to lane number, width, grades, and posted speeds. These differences are based on specific roadway functions within the roadway network and corridor capacity requirements. The primary roadways surrounding the South Park Bridge include SR-99, SR-509, E Marginal Way S., 14th/16th Avenue S., and Boeing Access Road. These are described below.

SR-99 is a limited-access state facility that also serves as a principal arterial. This roadway varies from 4 lanes to 6 lanes and provides South Park Bridge access to/from the south. The posted speed limit is 40 mph, lane widths are 12 feet, and grades are generally modest.

SR-509 is a limited access state highway that merges with SR-99 near E Marginal Way S. Three lanes are generally provided in each direction with access ramps at designated points along the corridor. Lane widths are 12 feet and the speed limit is 40 to 55 mph. Grades are modest and the roadway surface consists of asphalt. This facility is used as a major commercial truck route.

E. Marginal Way S. is a principal arterial with two to three lanes in each direction. This roadway provides bridge access to/from the north and access to activities related to various Boeing manufacturing facilities. Lane widths along the segment between 1st Avenue S. and Boeing Access Road range from 10 to 14 feet and the speed limit is generally 35 mph. Grades are modest and turn lanes are provided at major cross streets such as 16th Avenue S., S. Michigan Street, and Boeing Access Road.

14th/16th Avenue S. is a four-lane north-south major arterial connecting the key north-south corridors of E Marginal Way S. (to the north) and SR-99 (to the south). The South Park Bridge follows this 14th/16th Avenue S. alignment and provides one of the few crossing opportunities across the Duwamish Waterway. This roadway also serves as the principal route through the South Park community allowing access to several businesses on 14th Avenue S. between SR-99 and S. Cloverdale Street. Lane widths range from 9 (on the bridge) to 14 feet and the speed limit is 35 mph. Grades are generally modest with the exception of the bridge crossing and SR-99 interchange.

Boeing Access Road is a major east-west arterial that lies southeast of the South Park Bridge. This roadway provides access between E Marginal Way S./SR-99 and the I-5 corridor and consists of two to three lanes in each direction. No speed limit is given for segment west of I-5 and lane widths are generally 11 to 12 feet. Grades are moderate and the roadway surface consists of asphalt. At the intersection of Boeing Access Road & E Marginal Way S., dual westbound turn lanes are provided along with right-turn channelization for a free WB to NB movement.

S. Cloverdale Street is a designated principal east-west arterial that lies just south of the South Park Bridge. This roadway serves as a major truck route through the area and connects the SR-509 and SR-99 to 14th Avenue S. One lane of travel is provided in each direction between SR-99 and 14th Avenue S. while turn lanes are provided at major intersections. Parking is provided on both sides of the arterial and sidewalks exist on most segments west of 14th Avenue S. Grades along S. Cloverdale are generally modest and surfacing consists of asphalt. The speed limit is posted as 30 mph.

Airport Way is a north-south freeway "frontage" road that is designated as a principal arterial. This facility is used primarily as a commercial route for industrial and warehouse uses (high truck percentages) as well as a secondary by-pass for commuters. The roadway consists of two lanes in each direction with left turn channelization at major intersections. Grades are modest, pavement surfacing is conventional asphalt, and lanes are generally 11 to 12 feet wide.

Peak Hour Volumes

Peak hour intersection volumes for existing conditions were taken directly from manual turning movement field counts. AM peak period counts were conducted from 7 to 9 AM while PM peak counts were conducted from 4 to 6 PM. The single-highest volume peak hour was assumed to occur from 7:15 AM to 8:15 AM during the morning commute period and from 4 to 5 PM for the evening period based on the 15-minute traffic data. Included in this existing data are heavy vehicle volumes at the targeted intersections as well as pedestrian volumes by movement. Where possible, this volume data was compared to historical traffic counts from the City of Seattle. For some areas, refinements to these volumes were needed to ensure reasonable balancing between adjacent intersections (outbound to inbound volume matching), especially for closely spaced intersections such as those along 14th Avenue S. Critical intersections targeted for this evaluation include the following:

- E Marginal Way S & 1st Avenue S
- 16th Avenue S & S Cloverdale St
- E Marginal Way S & S Michigan St
- 14th Avenue S & S Trenton St
- E Marginal Way S & 4th Avenue S
- 14th Avenue S & Henderson St
- S Michigan St & 4th Avenue S
- S 96th St & Des Moines Memorial Dr
- SR-99 & Holden St
- E Marginal Way S & Boeing Access Rd
- E Marginal Way S & 16th Avenue S
- SR-99 & S 116th St

Level of Service

Operational analysis of AM & PM existing peak hour conditions was performed for each of the twelve signalized intersections using the *Synchro* analysis package, adhering to the analysis guidelines given in the *2000 Highway Capacity Manual*. Capacity analysis, as it is commonly referred to, is used to determine level of service (LOS) for various transportation facilities such as intersections, freeways, arterials, etc. With regard to intersections, separate methodologies are used to compute levels of service for signalized and unsignalized (stop-control) facilities.

The LOS range for signalized intersections is LOS A to LOS F, with the former indicating lower levels of congestion and the latter indicating high-delays and possible breakdown conditions. For unsignalized intersections, LOS A indicates high potential capacity and low delays, while LOS F indicates long delays and queues. Table 1 summarizes the relationship between level-of-service and delay for signalized and unsignalized intersections. Table 2 shows the results of the existing conditions LOS analysis. As shown in Table 2, results for the intersection of 1st Avenue S. & E. Marginal Way S. reflect a two-signal system (one for 1st Avenue S./E. Marginal Way S. and the other for 1st Avenue S. Bridge/E. Marginal Way S.) even though they operate in unison as a single signal. This was done in order to present operational conditions for each signal individually rather than as an average of two independent nodes.

TABLE 1
Intersection Level of Service Criteria

LOS	Signalized Delay (*seconds/vehicle*)	Unsignalized Delay (*seconds/vehicle*)	Traffic Flow Characteristics
A	< 10	< 10	Low Delays, virtually free flow, unimpeded
B	> 10 and ≤ 20	> 10 and ≤ 15	Stable flow with minor delays, less freedom to maneuver through the intersection
C	> 20 and ≤ 35	> 20 and ≤ 25	Stable flow with some delays, less freedom to maneuver through the intersection
D	> 35 and ≤ 55	> 25 and ≤ 35	Long delays and high density but stable flow and operations
E	> 55 and ≤ 80	> 35 and ≤ 50	Operating conditions at or near capacity
F	> 80	> 50	Forced operation, breakdown conditions

Source: 2000 High Capacity Manual

TABLE 2
Existing Peak Hour Level of Service

Intersection	Traffic Control	AM Peak Hour		PM Peak Hour	
		Delay	LOS	Delay	LOS
1st Ave S & E Marginal Way S	Signal	5.4	A	38.7	D
1st Ave S (Bridge) & E Marginal Way S	Signal	39.8	D	36.0	D
16th Ave S & E Marginal Way S	Signal	17.1	B	16.3	B
14th Ave S & S Cloverdale St	Signal	15.7	B	9.9	A
14th Ave S & S Trenton St	Signal	1.2	A	4.9	A
14th Ave S & Henderson St	Signal	2.9	A	8.7	A
S 96th St & Des Moines Mem Dr	Signal	6.6	A	9.3	A
E Marginal Way S & Boeing Access Rd	Signal	36.4	D	42.7	D
S 116th St & SR-99	Signal	17.5	B	16.5	B
Holden St & SR-99	Signal	31.8	C	36.6	D
S Michigan St & 4th Ave S	Signal	35.5	D	33.3	C
E Marginal Way S & S Michigan St	Signal	28.9	C	31.1	C
E Marginal Way S & 4th Ave S	Signal	7.3	A	12.3	B
System Performance Index	All	326		430	

Note: Delays given in seconds per vehicle

The results of Table 2 show low to moderately high system-wide delays for both the AM and PM peak hours with three intersections operating at LOS D. Higher congestion locations include 1st Avenue S./E. Marginal Way S. and E. Marginal Way S./Boeing Access Road. Some congestion is expected at these intersections as they carry the greatest amount of traffic during the critical peak periods of the day and serve as the "gateways" into the South Park area. Key movements in the S. Michigan Street/4th Avenue S./E. Marginal Way S. triangle also show moderate to high levels of congestion during both peak hours. Delays for intersections approaching the South Park Bridge along 14th Avenue S. and 16th Avenue S. are generally low with most delays for these locations at LOS A or LOS B. Analysis results for the remaining intersections show similarly modest delays with low levels of congestion for the majority of vehicle movements during the morning and evening peak periods.

The performance index, which provides an overall measure of system operations/conditions, shows similar congestion levels for the AM and PM peak hours on a system-wide basis. Vehicle queues for selected intersections and movements are shown in Table 3 below. Also shown in the table are available storage lengths that provide an estimate of how much space is physically given for vehicles waiting at an approach.

TABLE 3
Existing AM & PM Peak Hour Queues

Intersection	Movement	AM Avg Queue	PM Avg Queue	Storage (*Est*)
1st Ave S & E Marginal Way S	NW TH	135	150	230
	SE RT	220	1,500	>1,000
1st Ave S (Bridge) & E Marginal S	NB LT	1,700	700	>1,000
	SE TH	400	250	>1,000
16th Ave S & E Marginal Way S	SE TH	185	330	900
	NB LT	205	160	525
14th Ave S & S Cloverdale St	NB TH	190	145	540
	EB TH	150	70	450
E Marginal Way S & Boeing Access	NE RT	275	405	>1,000
	WB LT	220	485	800
S 116th St & SR-99	SB LT	100	460	475
	EB TH	210	215	>1,000
S Michigan St & 4th Ave S	NB TH	130	110	450
	EB LT	270	175	350
E Marginal Way S & S Michigan St	EB TH	790	265	750
	WB TH	75	240	320
E Marginal Way S & 4th Ave S	NW TH	60	90	660
	SE TH	50	145	460

Note 1: Queues reflect 95th percentile *total* in feet under non-metered upstream signal operation.
Note 2: Storage represents estimated available length based on existing roadway geometry

The queue analysis results indicate only modest vehicle stacking for most intersection approaches. Key movements approaches of interest include the 1st Avenue S./ E. Marginal Way S. approach, 1st Avenue S. Bridge/E. Marginal Way S. NB LT movement, and some movements at the E. Marginal Way S./Boeing Access Road intersection. Results for these specific movements show some queuing activity, though no spillback or influence to adjacent intersections appears to occur (based on the estimated storage lengths). Queues for the SB Left Turn movement at S 116th Street/SR-99/SR-599 are also noticeable for the PM peak hour when compared to the estimated storage length for these left turns. Nonetheless, sufficient vehicle storage is generally provided to accommodate current traffic loads at the majority of approaches in the system.

Accident History
Existing accident data for the targeted intersections in the study area was provided by King County and the City of Seattle. A summary of these accidents is provided in Table 4 on the following page. A star (*) indicates that no data was available for the time period examined. Though not shown in the table, the majority of accidents in were either angle-type or rear-end collisions. Side-swipe collisions also comprised a significant portion of the total accident pool. The majority of accidents occurred during daylight hours with either clear or cloudy weather and dry pavement conditions. For the 4 intersections where injury (possible or actual) data was available, approximately 40 to 50 percent of collisions involved a possible injury. No indications of fatalities were reported for any of the 12 locations examined.

TABLE 4
Accident History (1996 to 2001)

Intersection	1996	1997	1998	1999	2000	2001	**Total**	Inj	Fat
1st Ave S & E Marginal Way S	*	5	8	7	3	9	**32**	*	*
16th Ave S & E Marginal Way S	*	0	3	1	4	4	**12**	*	*
14th Ave S & S Cloverdale St	*	9	1	6	3	4	**23**	*	*
14th Ave S & S Trenton St	*	2	2	4	4	2	**14**	*	*
14th Ave S & Henderson St	*	4	7	5	2	5	**23**	*	*
S 96th St & Des Moines Mem	6	3	4	3	1	*	**17**	10	0
E Marginal Way S & Boeing Access Rd	8	4	3	3	7	*	**25**	5	0
S 116th St & SR-99	12	8	9	14	17	*	**60**	28	0
Holden St & SR-99	8	4	3	11	12	*	**38**	16	0
S Michigan St & 4th Ave S	*	4	0	4	5	7	**20**	*	*
E Marginal Way S & S Michigan St	*	11	4	7	5	2	**29**	*	*
E Marginal Way S & 4th Ave S	*	3	0	3	1	4	**11**	*	*

Non-Motorist Traffic
Pedestrian and bicyclist volumes near the South Park community are generally low. Turning movement traffic counts for both the AM and PM peak periods revealed few non-motorist trips through the targeted intersections. Based on field notes, fewer than 10 pedestrians and bicyclists were observed for each location during the two-hour peak period counts. Mid-day pedestrian volumes may be higher than the AM or PM peak periods due to lunch-related walking trips. This is especially applicable to areas within the South Park community. Based on the City of Seattle Bicycling Guide Map, 14th/16th Avenue S. is considered a "commonly-used" arterial by bicyclists though no designated bicycle lane is provided south of E Marginal Way S.

Transit Service
Transit routes serving the South Park community are primarily located along major north-south corridors such as E Marginal Way S. and 14th/16th Avenue S. Major King County Metro bus routes serving the area include *Route 60* (Broadway-White Center), *Routes 130* (Seattle-Des Moines) and *132* (Seattle-Des Moines) which travel along S. Cloverdale Street, *Route 154* (Auburn-Boeing), *Route 173* (Seattle-Fed Way), and Route *174* (Seattle/Sea-Tac/Fed Way). Headways vary significantly depending on the time of day. During the morning and evening commuter periods, however, headways are typically between 10 and 30 minutes. Off-peak headways range from 20 to 60 minutes depending on the route. Headways for Routes 130 and 132 along S. Cloverdale Street are roughly 20 minutes during the morning and evening commute periods.

Freight Movement

Freight movements in peripheral areas of the South Park community are noticeable due to the high concentration of industrial and manufacturing uses in the general area. Major heavy vehicle travel paths are primarily directed along E Marginal Way S. and SR-99 according to the City of Seattle Comprehensive Plan. S. Cloverdale Street is also used by trucks for access to SR-509 and SR-99 off of 14th Avenue S. and is the preferred route through the community. With respect to rail movements, the only freight-related crossing applicable to this study exists near the intersection of Marginal Way S. and 16th Avenue S. Field observations during peak commute traffic periods indicate no rail movements crossing the 16th Avenue S. approach. However, various off-peak site visits revealed some short-duration crossing activity. Trains generally consisted of only four to six cars.

2007 Year-of-Opening Conditions

Roadway Network

The roadway system assumed for the various Year 2007 design options incorporates the same basic network as that given in the Existing Conditions scenario with the exception of the South Park bridge lane configuration and a minor roadway narrowing along Des Moines Memorial Drive. For the No-Action scenarios (assumes either the existing bridge is still in place or a new bridge has been constructed), the only network change involves narrowing of Des Moines Memorial Drive from S 96th Street to S 112th Street from four lanes to three lanes (two lanes plus two-way left turn lane). The three-lane bridge scenario includes the Des Moines Memorial drive modification mentioned above as well conversion of the existing four-lane bridge cross-section to a three-lane section with two lanes provided in the southbound direction and one lane northbound. The No-Bridge scenario roadway network is similar the No-Action and three-lane option networks but removes the existing 14th/16th Avenue S. Bridge link. Improvements related to the SR-509 extension or Alaskan Way Viaduct are not included as part of the Year 2007 network.

Peak Hour Volumes

Future 2007 intersection volumes for each of the three year-of-opening scenarios were derived from travel demand forecasts given by the King County regional forecasting model. This model is based on the EMME/2 software platform and incorporates various land use, employment, roadway network, and population characteristics to determine future trip distribution patterns and peak period traffic volumes. King County has developed a base-year forecasting model calibrated to reflect 1998 traffic conditions as well as an approved long-range 2020 forecast model to represent future conditions.

Growth rates reflecting Year 2007 No-Action traffic levels were derived from both the established 1998 baseline and 2020 long-range forecasts using a conventional straight-line interpolation process. Actual turning movement volumes (i.e. those used for analysis) for the year 2007 No-Action scenario were developed by applying these growth rates to the existing traffic volumes collected specifically for this study.

Traffic volumes for the three-lane bridge scenario reflect the same basic land use, employment, and household elements as for the No-Action scenario but with the four-lane to three-lane bridge-related modification incorporated. Volumes for the No-Bridge option were developed through removal of the bridge link in the network and redistributing traffic to parallel or alternative routes in the system

(i.e. E. Marginal Way S., SR-99, Airport Way etc). The effects of this re-routing were most noticeable for E. Marginal Way S. at Boeing Access Road and 1st Avenue S. Based on the forecasts, redistribution to parallel arterials such as Airport Way and SR-99 would generally be minor.

Level of Service

Level-of-service calculations for future 2007 traffic conditions were performed for the three bridge alternatives (No-Action/bridge closed, Three-Lane, New-Bridge) to determine future congestion levels in the study area. Analysis results are summarized in Table 5.

To maintain a consistent frame of reference for this analysis, existing signal phasing and timing data were held constant for each scenario. This approach allowed for a more direct evaluation and comparison of the impacts of the various bridge design options by modifying only the traffic volume inputs. As shown in Table 5 average delays for the targeted intersections vary noticeably depending on the location and/or scenario in question. Specific locations with high levels of congestion and long delays include 1st Avenue S./E. Marginal Way S., 1st Avenue S. Bridge/E. Marginal Way S., E. Marginal Way S./Boeing Access Road, Holden Street/SR-99, S. Michigan Street/4th Avenue S., and S. Michigan Street/E. Marginal Way S. These high congestion levels generally apply to all three year-of-opening scenarios. Analysis results for these specific intersections indicate delays in the LOS D to LOS F range with some delays exceeding 100 seconds/vehicle (primarily for the No-Bridge scenario).

A comparison of Performance Index results between the No-Action alternative and Three-Lane option shows similar congestion levels (± 5 percent). This similarity is expected given that the reconfiguration of lanes on the bridge from four lanes to three would not significantly redistribute traffic. However, for the No-Bridge option, removal of the South Park Bridge link would force local traffic onto alternative routes, thereby inducing a shift in trip concentration to the SR-99 and E. Marginal Way S. corridors. This would result in higher delays at critical gateway nodes such as 1st Avenue S./E. Marginal Way S., E. Marginal Way S./Boeing Access Road, and E. Marginal Way S./S. Michigan Street. Congestion levels for these specific locations would likely be near or at breakdown conditions (LOS F) by the mid-term 2007 horizon year with delays exceeding 80 seconds per vehicle on average. Performance Index values for the No-Bridge option are roughly 30 percent higher than for No-Action conditions.

TABLE 5: Future 2007 Peak Hour Level of Service

Intersection	2007 No Action				2007 Three-Lane Bridge				2007 No-Bridge			
	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
1st Ave S & E Marginal Way S	5.9	A	58.7	E	5.7	A	66.0	E	5.7	A	64.3	E
1st Ave S (Bridge) & E Marginal Way S	59.8	E	34.1	C	72.5	E	33.4	C	102.1	F	37.5	D
16th Ave S & E Marginal Way S	17.4	B	16.8	B	14.9	B	15.0	B	3.9	A	5.7	A
14th Ave S & S Cloverdale St	16.6	B	10.6	B	14.4	B	9.7	A	7.4	A	9.4	A
14th Ave S & S Trenton St	1.3	A	5.0	A	1.1	A	4.8	A	1.2	A	4.1	A
14th Ave S & Henderson St	2.9	A	8.8	A	2.9	A	8.8	A	2.9	A	6.1	A
S 96th St & Des Moines	8.0	A	10.3	B	6.9	A	10.1	B	6.6	A	7.8	A
E Marginal Way S & Boeing Access	46.6	D	60.3	E	47.2	D	60.6	E	54.2	D	67.4	E
S 116th St & SR-99	18.9	B	18.8	B	18.9	B	18.7	B	18.8	B	20.6	C
Holden St & SR-99	39.1	D	43.6	D	38.6	D	44.9	D	40.3	D	56.8	E
S Michigan St & 4th Ave S	38.6	D	35.2	D	50.5	D	37.7	D	54.8	D	42.5	D
E Marginal Way S & S Michigan St	41.8	D	41.2	D	55.8	E	35.3	D	97.0	F	105.5	F
E Marginal Way S & 4th Ave S	7.7	A	12.3	B	8.4	A	13.7	B	9.7	A	11.7	B
System Performance Index	445		578		498		605		639		761	

Note: Delays given in seconds per vehicle

Non-Motorist Traffic

The impacts of the various Year 2007 design options on non-motorist traffic in the South Park community depend somewhat (though not critically) on whether or not the bridge facility is closed and removed. For the No-Action or "do nothing" alternative in which the current bridge remains in place, no impacts to existing pedestrian/bicyclist activity would occur. Only modest increases in non-motorist volumes due to natural background growth would occur. For the three-lane bridge option, wider shoulders and sidewalks could be provided on the bridge deck due to the reconfiguration of the bridge cross-section from four lanes to three lanes. This change could potentially improve non-motorist safety by reducing bridge-related traffic friction. If the bridge is closed and removed, all non-motorist traffic using the bridge as a north-south connector would

be eliminated. However, overall pedestrian/bicyclist patterns would not change dramatically due to the low number of non-motorist trips currently using the bridge.

Transit Service
Impacts to transit service for the No-Action and Three-Lane alternatives would be negligible since no re-routing of service would be required. By the 2007 timeline, transit service levels would increase system-wide based on long-range King County Metro service plans. For the No-Bridge option, transit service for specific routes would be eliminated due to removal of the bridge link from the network. Affected routes would include Routes 60 and 132. Alternative routing paths would likely be developed to ensure that existing transit markets in the area are not abandoned.

Freight Movement
Freight mobility would not likely be impacted for the two bridge options that maintain a crossing over the waterway (i.e. the No-Action and Three-Lane options) since current routing patterns could continue. However, for the No-Bridge option, removal of the bridge link would potentially require truck rerouting for access to/from destinations on either side of the waterway. This rerouting would be captured at the north and south gateway intersections of 1st Avenue S./E. Marginal Way S. and E. Marginal Way S./Boeing Access Road intersections, respectively and is reflected in the traffic analysis.

Year 2027 Conditions

Roadway Network
Roadways included in the two Year 2027 design options are similar to those given in the corresponding Year 2007 scenarios. Two long-range analysis scenarios are examined for the 2027 horizon year: A "New Bridge" replacement option that assumes a completely new 4-lane fixed structure and a "No Bridge" option that assumes bridge structure is closed. From a traffic operations perspective, the bridge replacement or "New Bridge" option is similar to the 2007 No-Action scenario in that a 4-lane bridge facility is maintained over the waterway. The No-Action designation for 2027 conditions reflects removal of the bridge (whereas the existing bridge is assumed to remain in the 2007 No-Action option) since the existing structure would not survive out to the 2027 horizon. The Three-lane bridge scenario is not examined for 2027 conditions. Long-range regional improvements related to the SR-509 extension are included as part of the Year 2027 network. However, Alaskan Way Viaduct improvements are not included.

Peak Hour Volumes
Future 2027 intersection volumes for each of the two analysis scenarios were derived from travel demand forecasts given by the King County regional forecasting model. As described previously, this model is based on the EMME/2 software platform and incorporates various land use, employment, roadway network, and population characteristics to determine future trip distribution patterns and peak period traffic volumes. Growth rates reflecting Year 2027 New-Bridge traffic levels were derived from the established 1998 baseline and 2020 long-range forecasts using a straight-line extrapolation process. Overall traffic growth from 1998 to 2020 was annualized (year-to-year growth) and extrapolated out to the 2027 horizon. Detailed turning movement volumes for the 2027 New Bridge scenario were subsequently developed by applying these annualized growth rates to the existing peak hour traffic volumes.

Traffic volumes for the No-Bridge or "No-Action" scenario reflect the same basic process as for the New Bridge alternative but with the bridge link removed from the network. This option incorporates an area-wide redistribution of north-south traffic flow (normally taking the South Park Bridge route) to parallel or alternative routes in the system such as E Marginal Way S. or SR-99, and Airport Way. As with the 2007 traffic rerouting patterns, impacts to E. Marginal Way S. at Boeing Access Road and 1st Avenue S. are most noticeable (based on link volume estimates). Traffic redistribution to SR-99 and Airport Way would be minor in comparison. Peak hour traffic volumes for the Year 2027 scenarios are shown in the Figures 6 and 7 (previous pages).

Level of Service

Level-of-service calculations for future 2027 traffic conditions were performed for the two bridge alternatives. AM and PM peak hour traffic conditions were evaluated for a total of four long-range scenarios. These calculations were made using the *Synchro* analysis program described previously. Level-of-service and delay results are shown in Table 6 below.

TABLE 6: Future 2027 Peak Hour Level of Service

Intersection	2027 New-Bridge				2027 No-Bridge			
	AM Peak		PM Peak		AM Peak		PM Peak	
1st Ave S & E Marginal Way S	6.6	A	98.4	F	7.7	A	97.4	F
1st Ave S (Bridge) & E Marginal Way S	>100	F	48.4	D	>100	F	57.7	E
16th Ave S & E Marginal Way S	17.5	B	26.4	C	4.2	A	10.3	B
14th Ave S & S Cloverdale St	22.4	C	19.5	B	7.5	A	9.8	A
14th Ave S & S Trenton St	1.6	A	5.3	A	1.5	A	4.1	A
14th Ave S & Henderson St	2.8	A	7.7	A	3.8	A	5.8	A
S 96th St & Des Moines	9.6	A	30.2	C	6.6	A	12.2	B
E Marginal Way S & Boeing Access Rd	57.6	E	>100	F	74.1	E	>100	F
S 116th St & SR-99	19.5	B	24.1	C	20.3	C	26.0	C
Holden St & SR-99	37.4	D	40.4	D	36.0	D	40.6	D
S Michigan St & 4th Ave S	66.3	E	38.4	D	60.8	E	39.5	D
E Marginal Way S & St Michigan St	59.0	E	58.7	E	95.0	F	82.9	F
E Marginal Way S & 4th Ave S	7.3	A	17.3	B	9.8	A	16.2	B
System Performance Index	684		987		758		996	

Note: Delays given in seconds per vehicle

As with the 2007 analysis, existing signal phasing and timing data were held constant (i.e. no optimization of the signals) for each scenario to ensure that a consistent frame of reference was maintained throughout the analysis process. As shown in Table 6, analysis results for the New-Bridge alternative indicate high levels of congestion at the primary gateway intersections for both the AM & PM peak hour periods. Specific locations of interest include 1st Avenue S./E. Marginal Way S., E. Marginal Way S./Boeing Access Road, S. Michigan Street/4th Avenue S., and E. Marginal Way S./S. Michigan Street. Delays for these intersections would be expected to fall into the LOS E or LOS F range with average delays of more than 60 seconds per vehicle. Results for the No-Bridge scenario show similar results to the New-Bridge option but with

slightly greater congestion levels. Critical gateway intersections with the bridge link removed operate at either LOS E or LOS F.

A comparison of performance-index values for the two scenarios shows higher traffic congestion in the AM peak hour for the No-Bridge option and similar congestion levels during the PM peak. The rerouting of traffic volumes in the PM peak hour appears to have less of an effect on delays than in the AM peak hour, most likely due to the already high volumes and congestion levels during the PM peak at the key intersections. The net change in volumes (on a percentage basis) from the 14th/16th Avenue S. route to SR-99 or E. Marginal Way S. would be modest compared to the total volumes on these corridors. As such, only incremental changes in PM peak hour delays would occur. This is also the case for the morning peak hour; however, this balancing effect is likely to be more exaggerated during the PM peak.

Non-Motorist Traffic
As with the 2007 scenarios, impacts of the two Year 2027 design options on non-motorist traffic depend somewhat on whether or not the bridge facility is closed and removed. For the New-Bridge alternative in which the current bridge is replaced by a similar (though most likely fixed) facility, no impacts to existing pedestrian/bicyclist activity would occur. Some increase in peak period non-motorist traffic volumes is expected due to background growth and higher land use densities. If the bridge is closed and removed, as the No-Action option suggests, non-motorist traffic would be eliminated. Overall pedestrian/bicyclist travel patterns would not change dramatically even with this link removal based on the low number of non-motorists currently using the bridge and future land use patterns for the surrounding area (expected to remain industrial-based). However, those users that depend on the bridge to cross the waterway, such as those in the South Park community, would be forced to use inconvenient alternative routes.

Transit Service
Impacts to transit service for the New-Bridge alternative would not occur since no re-routing of service would be required. Transit service levels by 2027 would increase system-wide based on long-range King County Metro service plans, but not far beyond short-range 2007 levels due to the incorporation of new Light-Rail Transit (LRT) service. For the No-Bridge option, transit service for Routes 60 and 132 (if still in operation) would be eliminated due to removal of the bridge link from the network. However, new or modified routes and service levels would likely be implemented to ensure that transit service is maintained in the South Park area.

Freight Movement
Freight mobility and accessibility would not be significantly affected for the New-Bridge option since it would maintain a crossing over the waterway. However, for the No-Bridge option, removal of the bridge link would require some truck rerouting for access to/from destinations on either side of the existing bridge. Impacts of this rerouting would be reflected at the north and south gateway intersections of 1st Avenue S./E. Marginal Way S. and E. Marginal Way S./Boeing Access Road intersections. The traffic analysis results for 2027 No-Bridge conditions incorporate these rerouting patterns and subsequent changes in traffic volumes in terms of additional delays and vehicle travel times.

Duwamish Traffic Navigability

The Duwamish Waterway is navigable from Elliott Bay south to the turning basin, located at a bend in the waterway between the Oxbow site and the Developmental Center. Shipping activity on this portion of the waterway is minimal. The existing South Park Bridge has a maximum vertical clearance above the waterway of 32 feet at MHHW and opens an average of three to five times per day to accommodate the both industrial and recreational vessels. All alternatives match or exceed the horizontal clearance of the existing channel. Both the rehabilitated and all of the movable bridge alternatives in their open position offer unlimited vertical clearance. Based on previous documentation, the U.S. Coast Guard preliminary findings found that the high profile bridge with 100-foot clearance satisfies navigation clearance requirements. (This will be further evaluated during this study process). The Fixed Mid-Level Alternative, 60 foot clear of the waterway, restricts two existing businesses upstream of the bridge and potential future waterway users from fully utilizing their facilities. The Fixed Low-Level Bridge Alternative, although meets the clearances of the existing facility, would have significant impacts to existing and future waterway users and businesses.

DESIGN/CONSTRUCTION MEASURES

Safety

Descriptions of all the alternatives were given in the beginning sections of this document. All 2% alternatives were developed at this time with safe design for motorized vehicles, pedestrians and bicyclists. No design deviations to the King County Design Standards with the exception of using a design speed of 35 mph (versus King County standard of 45mph) are utilized at this time.

The two concerns outlined in the screening criteria with respect to safety revolve around roadway steepness/profiles on the approaches to the bridge and potential aviation clearances due to the proximity of Boeing Field.

Seismic Integrity

In the screening of the alternatives, PB evaluated each alternative and its potential conformance with the requirements of current AASHTO design specifications, as well as the proposed "Recommended LRFD Guidelines for the Seismic Design of Highway Bridges" (Recommended Guide Specifications), prepared under the MCEER Highway Project 094, Task F3-1. This Recommended Guide Specifications is expected to be adopted by Washington State Department of Transportation in the very near future.

The current design based on existing AASHTO provision uses a probabilistic map of peak ground acceleration (PGA) on rock, which was developed by the U.S. Geological Survey (USGS, 1990). The map provides contours of PGA for a probability of exceedance (PE) of 10% in 50 years, which is approximately 15% PE in the 75 year design life of a typical highway bridge. The Recommended Guide Specifications provide more definitive performance

objectives and damage states for two level design earthquakes: The upper-level event, termed Maximum Considered Earthquake (MCE), has ground motions that have a probability of exceedance of 3% in 75 years. The MCE earthquake governs the limits on the inelastic deformation in the substructures and the design displacements for the support of the superstructure. The lower-level design event, termed the Expected Earthquake, has ground motions corresponding to 50% PE in 75 years. This design level requires that essentially elastic response is achieved in the substructures for the more frequent or "expected" earthquake.

The structural ductility demand to capacity ration is a major design consideration for the conformance to the requirements. Among the alternatives, the fixed-span bridges would have a better probability to meet the ductility demand at the design level earthquake. The movable bridges are generally less ductile, thus would have challenges to design for the ductility demand.

Construction Permitting

PB evaluated the alternatives based on the likely construction permitting issues that would arise for each design alternative. Significant environmental impacts (water quality, fisheries, tribal fishing, and navigation) would occur from the construction of piers in the Duwamish River. Different, but equally significant environmental impacts would occur from the construction of a tunnel design due to the anticipated problems associated with constructing using cut-and-cover methods in an area known to have hazardous substances. Disposal of potentially contaminated soils and the disturbance of contaminated soils that could result in release of hazardous substances into the water could be problematic. Moreover, all of the new bridge alternatives would impact the local business community and several potentially historic buildings.

In the analysis of the alternatives, the No Action Alternative was seen as the alternative that would result in the fewest permitting obstacles. No construction of new facilities would occur, but some minor construction activities would be likely to abandon the bridge in place and to ensure the structure is safe and does not become an attractive nuisance. Fairly significant construction permitting would be required for the rehabilitation of the Retrofit Alternative, but these activities would basically be classified as repair and maintenance activities. The extent of these activities and the associated permitting would also be expected to be less than those required to demolish the existing bridge and to construct either a new bridge or the Tunnel Alternative. The construction of the fixed-span and movable-span alternatives would all require a significant amount of construction activities, so would likely require more permits and the approval process for those permits would likely be longer in duration than the permits required to rehabilitate the existing bridge. The most arduous permitting would most likely be associated with the construction of the Tunnel Alternative. This alternative would have all of the same permitting issues as the other build alternatives, but the magnitude and complexity of the construction activities would likely require a more lengthy time to obtain required permits. In addition, the extensive excavation associated with the cut-and-cover construction in a contaminated area would also be expected to make the permitting of this alternative most difficult of all of the alternatives.

Construction Duration

In the screening of the alternatives, PB evaluated the construction duration of each alternative, in relative to the others. Many factors influence the estimate of the construction durations. Major factors include potential relocations, fish window, structure types, construction methods and constraints, etc. Depending on the structural type, the fixed span bridges could have relatively short duration for in-water construction activities. The Tunnel Alternative has a longer structure and also the underground structure usually takes longer time to construct. However, if a bored tunnel is feasible, the majority construction activities would be underground, thus less disturbance on the ground. The movable bridge alternatives may take longer lead-time for the fabrication of steel parts, and longer period of construction activity in the water for the massive piers.

Utility Impacts

There exists an operational railroad track along E. Marginal Way S. Other existing minor utility along the proposed project corridor include overhead power, telecommunications, and lighting. There is also underground drainage running along both sides of 16th Avenue S. For the most part, all minor utilities along the 14th Avenue S. and 16th Avenue S. would be impacted and require relocations.

Maintenance of Traffic and Local Access During Construction

These screening criteria evaluate the degree to which general purpose traffic can be accommodated and local access can be maintained during construction of each of the alternatives. For the most part, the Fixed High-Level Bridge and Fixed Mid-Level Bridge alternatives have the most significant impacts to maintenance of traffic during construction due to the "touchdown" points and the transitions into the existing roadway. All the low-level alternatives would have moderate impacts compared to the other alternatives. The No Action Alternative (bridge closure) would have the least amount of disruption during construction.

FINANCIAL PERFORMANCE

Construction Costs

PB evaluated the alternatives based on the anticipated magnitude of construction costs. No conceptual cost estimates have been prepared for any of the alternatives to date, so specific cost figures could not be used in this analysis. Moreover, cost estimates for property acquisition or mitigation requirements have not been evaluated.

The underlying basis for the comparison of the alternatives is the comparative costs for demolition and the construction of structures. The assumption is that costs to construct a fixed-span would be approximately half the cost of a movable-span due to the high costs of equipment to operate a movable span. The cost of a tunnel would likely be more than double the cost for a

movable-span bridge because of the extremely high costs for ground excavation, irrespective of whether a tunnel-boring machine or a cut-and-cover method were to be used.

In this analysis of the alternatives, the No Action Alternative would be the least costly of the alternatives as the bridge would be closed, but not demolished. The fixed-span bridges would be more costly, though the cost of the Fixed High-Level Bridge Alternative could approach the cost of a movable bridge due to the longer structure. In magnitude, the construction costs for one of the movable bridge designs would generally be more than the fixed-span bridge designs and would be expected to be similar in magnitude for each of the three types of bridge designs (bascule, vertical lift, or swing). As stated above, the cost of the Tunnel Alternative would exceed the construction costs for any of the other alternatives. The construction costs for the Retrofit Alternative (if feasible) is the most unpredictable, depending on the existing condition and the level of rehabilitation required. As a first guestimate, it would likely be similar in magnitude to the cost of the Fixed Low-Level Bridge Alternative due to the extensive construction work anticipated to stabilize the bridge piers.

Operation and Maintenance Costs

PB evaluated the alternatives based on the conceptual magnitude of operation and maintenance costs. No specific estimates have been prepared at this time, so specific cost numbers could not be compared. The focus of this analysis considered anticipated costs for road maintenance, bridge structure maintenance, labor to operate equipment of movable-span bridge alternatives, routine maintenance costs for the equipment used in the movable-span bridge alternatives, and potential costs for on-going repair and rehabilitation costs.

In the analysis of alternatives, each of the fixed-span bridge designs would incur costs for road and bridge structure maintenance costs. The No Action Alternative would be expected to be the least costly of any of the project alternatives, as none of these costs would be incurred. The movable-span bridge designs would incur costs for road and bridge structure maintenance costs, labor costs, as well as equipment maintenance costs. As such, the operation and maintenance costs of the movable-span bridge alternatives would be expected to be higher than the costs for the fixed-span bridge alternatives. The Tunnel Alternative would incur costs for road and tunnel structure maintenance costs, and ventilation costs. The operation and maintenance costs for this alternative would largely depend on the ventilation and fire suppression equipment requirements. Due to the fact that the existing bridge is old and in poor condition, the initial rehabilitation of the bridge would not likely last for more than 10 or 15 years. As such, major reconstruction activities would need to be performed to maintain the bridge for a period of time comparable to the expected life of a new bridge.

Impacts to Tax Base

PB conducted a preliminary analysis of potential impacts to the local tax base. Government revenues from property taxes, sales taxes, as well as business and occupation taxes were considered. The government revenues from these taxes were particularly reviewed with respect to the commercial and industrial businesses specifically located in the project area. The potential loss of property tax revenues due to the acquisition of right of way was not included in this analysis.

On 14th Avenue S., there are a number of small retail commercial establishments, medical offices, and small warehouse businesses. The gross receipts and employment of each of these businesses would generally be expected to be relatively small in comparison to the Boeing operations located north of the river. The Sea Mar community health clinics located in the 8900-block of 14th Avenue S. employ approximately 470 medical, professionals, and support staff. In addition, several large marinas and a mega-yacht construction and repair facility are located upstream of the existing bridge. Together, these businesses provide employment for several hundred workers.

Moreover, tall boats requiring bridge clearance of up to 100 feet must pass under the existing bridge to be repaired. Another business in the area, the Boeing Company, currently uses barges to transport large industrial parts upstream of the existing 16th Avenue S. Bridge

There are several key issues that were evaluated with regards to potential impacts to these businesses. One was the height of the proposed alternative bridge designs and how water-dependent commerce would be affected. Some businesses would not be affected. Others would be impacted, but alternative means of transport could be used but at a much higher cost. For other businesses, there would be no other feasible means of transportation and the economic viability of the business would be placed in jeopardy.

In the analysis of the alternatives, the No Action and the Retrofit alternatives would result in little to no change from existing conditions. Existing area businesses would continue to contribute to government revenues. The height of the bridge deck of the different alternatives could potentially affect marinas and a mega-yacht construction and repair facility located upstream of the 16th Avenue S. Bridge. The Fixed Low-Level Bridge Alternative would adversely impact the current use of the waterway by both upstream businesses and potentially the Boeing Company. The Fixed High-Level Bridge Alternative, several movable-span bridge alternatives, and the Tunnel Alternative all would continue to guarantee bridge clearances of up to 100 feet. These alternatives would allow these businesses to continue to operate without significant changes. Only the Fixed Mid-Level Bridge Alternative would prohibit continued transport of some boats to the upstream businesses, including the barge-mounted cranes used by the mega-yacht construction and repair business. This alternative, however, would likely allow sufficient clearance for continued barging of airplane parts upstream of the 16th Avenue S. Bridge. Considering the higher construction as well as operation and maintenance costs of the movable-span bridges compared to the value of goods shipped upstream of the bridge (and potential costs to relocate upstream water-dependent businesses), the Fixed Mid-Level Bridge Alternative could have potentially adverse effects on local businesses and local tax revenues.

Potential Alternatives	Regional Mobility	Local Access	Duwamish Waterway Navigation	Community Impacts	Aquatic Habitat Protection	Construction Impacts	Project Costs
No Action	Severe Impacts	Significant Changes	No Impacts	Most Impacts	Substantial Improvement	Low	Low
Fixed High-Level Bridge	Moderate Impacts	Significant Changes	Minimal Impacts	Most Impacts	Moderate Improvement	High	Moderate
Fixed Mid-Level Bridge	No Impacts	Moderate Changes	Moderate Impacts	Moderate Impacts	Moderate Improvement	Moderate	Moderate
Fixed Low-Level Bridge	No Impacts	Minimal Changes	Severe Impacts	Least Impacts	Moderate Improvement	Low	Moderate
Movable Bascule Bridge	No Impacts	Minimal Changes	Minimal Impacts	Least Impacts	No Noticeable Improvement	Low	High
Movable Vertical Lift Bridge	No Impacts	Minimal Changes	Minimal Impacts	Least Impacts	No Noticeable Improvement	Low	High
Movable Swing Bridge	No Impacts	Minimal Changes	Minimal Impacts	Least Impacts	No Noticeable Improvement	Low	High
Tunnel	Moderate Impacts	Significant Changes	Minimal Impacts	Most Impacts	Substantial Improvement	High	Very High
Retrofit	Minimal Impacts	Minimal Changes	Moderate Impacts	No Impacts	Moderate Increased Impact	High	High

Figure 13: Evaluation Matrix of Potential Alternatives

Appendix H. Rehabilitation Feasibility Study Technical Memo